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PHYSICS.—*The brightness of optical images.* P. G. NUTTING, Eastman Kodak Research Laboratory.

The relative brightness of an object and its image formed by a lens may be calculated by certain well known formulae when the relative aperture of the lens is small and the object distance great. Experimental determinations of relative brightness have been made but not with sufficient precision to permit of a satisfactory deduction of the light lost during transmission through the lens.

In this article are given first an extension of the theory to lenses of all apertures and focal lengths and to all object distances. A method is described of measuring relative illumination with a precision as high as that reached in the best ordinary photometry. Both investigations were initiated and carried out at the research laboratory of the Eastman Company. The unabridged paper (to appear elsewhere) contains the complete mathematical theory and experimental data.

The theoretical investigation leads to an expression for the flux density I of radiant power, in watts per unit area, entering the image, relative to that (I_0) leaving the object. This expression is in terms of radius of effective aperture R of the lens, distance of object u and image v measured from the nodal point of the lens. The formula is simplified if we substitute magnification m for the ratio v/u of image distance to object distance, and introduce the symbol $a = R/F$, the ratio of the radius of effective aperture to equivalent focal length F. The complete formula is

$$\frac{I}{I_o} = \pi M \left[M \log \frac{1+S}{1+T} - \frac{T}{1+T} \right]$$

in which $M = \dfrac{1}{1-m^2}$ $S = \dfrac{a^2}{(1+m)^2}$ and $T = m^2 s$

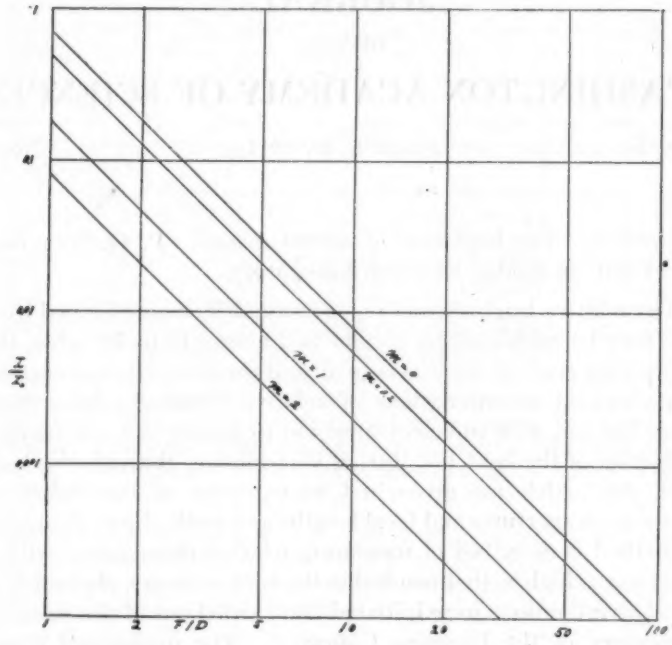

Fig. 1

In the special case of a very distant object, this expression simplifies to $\pi \log (1+a^2)$ or for narrow apertures to the ordinary formula $I = I_0 \pi a^2$. When image and object are at equal distances ($m = 1$),

$$\frac{I}{I_o} = \frac{1}{2} \pi a^2 \frac{8+a^2}{(4+a^2)^2}$$

The relative brightness of image and object, computed by the above formulae for any lens aperture F/D and any magnification $m = v/u$ is given in the following table:

APERTURE	$m = 0$	$m = .1$	$m = .2$	$m = .5$	$m = 1$	$m = 2$
1	.704	.580	.521	.333	.179	.0775
2	.1902	.1580	.1321	.0864	.4091	.0210
5	.0312	.0255	.0219	.01296	.00785	.00347
10	.00785	.00625	.00553	.00349	.00197	.000870
20	.00196	.00162	.00134	.000878	.000490	.000217
50	.000314	.000259	.000216	.000135	.000078	.0000346
100	.000878	.000065	.000051	.000044	.000019	.0000086

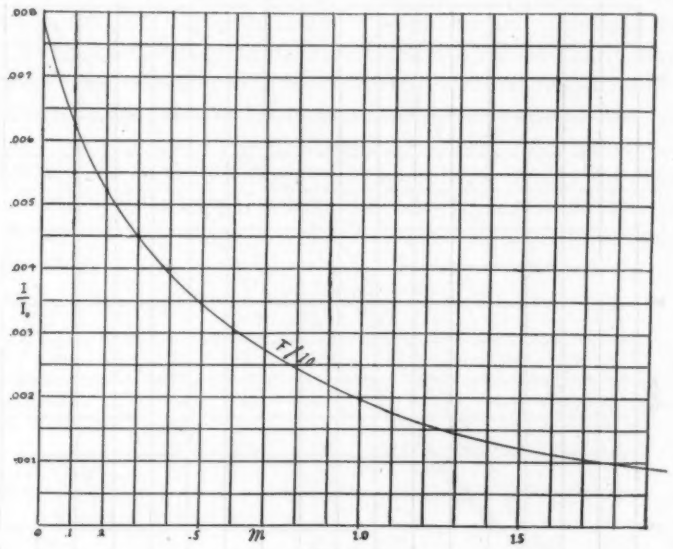

Fig. 2

Figure 1 shows relative brightness plotted against relative apertures, both on logarithmic scales. The curves are sensibly straight lines.

Figure 2 shows the variation of relative brightness with relative distance of image and object, v/u. Relative brightness decreases rapidly at first, then slowly and steadily to zero for great magnifications.

In measuring relative illuminations the arrangement finally adopted was that shown in figure 3. The test object was a sheet

of opal glass S, 14 inches square, forming the front face of a cubical box containing a tungsten lamp of 1500 candle power. Opposite the source, 5 meters distant, was a white magnesia block

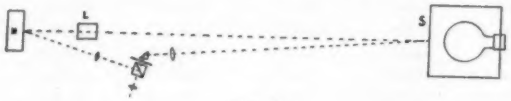

Fig. 3

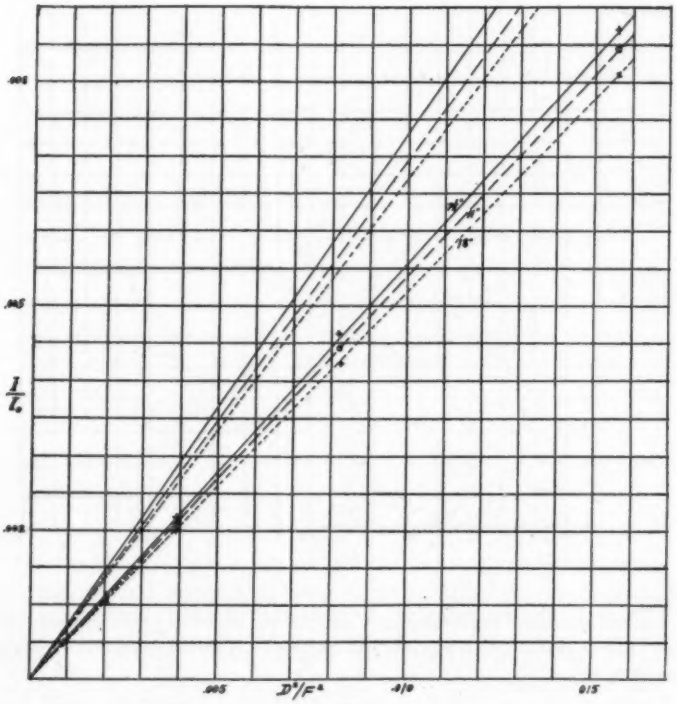

Fig. 4

M upon which an image of the source could be thrown by the lens L under test. The brightness of this image was compared with that of the same spot with the lens removed by means of a modified Beckstein illuminometer.

The relative brightness of block (without lens) and source $I_1:I_0$ is the area of the source divided by the square of the distance to the *edge* (not center) of the source to within 0.1 per cent error. Relative brightness of image and block without lens is the measured ratio $I_2:I_1$, hence the desired relative illumination of image and object $I_2:I_0$ is obtained by multiplication. Since the comparison screen of the photometer is illuminated directly by the source, there is no curve due to fluctuations in the source by mat-black walls, and the remainder is measured and corrected for.

The results obtained on the different lenses are tabulated below. For each test are given the numerical aperture at which the text was made, the relative brightness I_1/I_0 of source and receiving block, relative distance m of image and object, observed relative brightness I_2/I_0, the same quantity computed—neglecting losses by reflection and absorption (B)—and finally the ratio of observed to computed brightness T which is the percentage transmission of the lens.

LENS	NO.	SERIES	EFL	AP.	$I_1:I_0$	m	$I_2:I_0$	B	T
Cooke Process.....	32051	V	18″	F/8	.00475	.0865	.00820	.01058	.78
Cooke Process.....	31796	V	11″	8	.00475	.0675	.00841	.01085	.78
Cooke Process.....	33991	V	7½″	8	.00475	.0417	.00870	.01136	.77
B. & L.-Z. Tessar.	1320682	1C	6″	4.74	.00494	.0309	.0249	.0528	.76
Cooke.....	40399	1C	8″	4.72	.00499	.046	.0237	.0321	.74
Fuess Tel. Objective.....			6″	5.3	.00494	0.33	.0257	.0278	.92
B. & L.-Z. Tessar.	95933	1C	40 mm.	4.94			.0172	.0322	.54
Cooke Cine.....			2″	3.67			.0393	.0585	.67
Zeiss-Krauss Tessar.....			75 mm.	3.69			.0330	.0579	.57
Zeiss-Krauss Tessar.....			150 mm.	4.71			.0234	.0355	.66

If there be no absorption of light within a lens, a transmission of .76 corresponds, for 6 air glass surfaces, to a mean refractive index of about 1.55; hence the higher observed transmissions are quite up to theoretical possibility.

The first five lenses in the above list were used at various measured apertures. Data are given in the following tables, and in the curves of figure 4.

STOP	18 INCH COOKE SER. V			11 INCH COOKE SER. V			7½ INCH COOKE SER. V		
	Obs.	Comp.	Trans.	Obs.	Comp.	Trans.	Obs.	Comp.	Trans.
F/8	.00820	.01058	.774	.00841	.01085	.776	.00870	.01136	.766
11	.00374	.00459	.816	.00441	.00570	.774	.00463	.00600	.770
16	.00206	.00264	.783	.00210	.00270	.779	.00202	.00283	.714
22	.00108	.00140	.773	.00116	.00143	.781	.00115	.00150	.766
32	.00524	.000661	.792	.00051	.00067	.762	.00050	.00071	.72
45	268	336	.796						
64	156	166	.94						
90	100	083	.83						

The Tessar and Cooke F/4.5 lenses gave results as follows:

STOP	B.-L.-E. TESSAR Ic.			STOP	8 INCH COOKE SERIES II		
	Obs.	Comp.	Trans.		Obs.	Comp.	Trans.
F/4.74	.0249	.0328	.758	F/4.72	.0237	.0321	.739
5.66	.0184	.0238	.724	5.68	.0172	.0232	.744
8	.00890	.0115	.766	8	.00836	.0112	.749
11	.00476	.00610	.765	11	.00425	.00595	.715
16	.00231	.00288	.804	16	.00210	.00282	.664
22	.00115	.00152	.765	22	.00117	.00149	.800
32	.00054	.00072	.750				

These tables show a fair constancy of transmission T as the stop is varied. It may be noted further that the departure of actual from indicated aperture ratio is the same in the high speed lenses of different makes.

PHYSICS.—*The production of temperature uniformity in an electric furnace.* ARTHUR W. GRAY. To appear in full in the Bulletin of the Bureau of Standards.

In the present paper certain improvements of the electric furnace described several years ago by the writer[1] are presented; experimental evidence shows that it is possible in the new furnace to heat a region of considerable length to any desired temperature up to about 700° C. so uniformly that irregularities in the temperature distribution will be less than the effect of heterogeneity

[1] Journ. Wash. Acad. Sci. **2**: 250. 1912.

in thermoelements of the best quality, and probably less than the uncertainties at present existing in our knowledge of the temperature scale itself. The method has been applied to a furnace designed to heat uniformly bars under measurement for thermal expansivity; but the application of it clearly is not limited to problems of this general character.

The iron tube of the trial furnace,[2] together with its contents, is retained without essential alteration. The principal change consists in removing the heating coil from the tube upon which it had formerly been wound and substituting two independent concentric heaters to supply heat uniformly for the entire length of the interior. In the experiments so far made air has formed the insulation, filling the small annular space separating the original tube from the first heater, and also the larger space between the heaters, except for some layers of mica and of asbestos cloth, in all about 4 mm. thick, wrapped tightly around the ribbon of the inner heater. The outer one is covered in the same way, and the space between this and the casing of the whole furnace is filled with asbestos-magnesia compound. The end plugs consisting of two thick blocks of a good heat conductor separated by a thick layer of a poor conductor are attached to large insulating heads filling the entire cross-section of the casing. In most of the experiments heat was supplied to the plugs by means of coils filling the grooves turned in the outer conducting blocks, just as in the former furnace; but recently considerable improvement was effected by cutting these coils out of action, and substituting flat coils of the same diameter as the outer heater, against the ends of which they bear.

The concentric heaters are of nichrome ribbon wound longitudinally, instead of helically, upon iron pipes. A flat mat is made of the resistor ribbon and strips of micabeston[3] woven together in basket fashion. This is wrapped about the heater tube (previously covered with a layer of micabeston), and the opposing ends of each insulating strip are lapped for a short distance

[2] For an illustrated description see the communication cited above.

[3] An insulating preparation of mica flakes and a resinous cement pressed into large, thin, flexible sheets.

and tucked under alternate lengths of the ribbon. Then follows another layer of micabeston and, finally, a wrapping of asbestos cloth. As each layer is applied it is drawn down firmly by a tight helical bandage of cotton tape, which is removed as soon as the layer has been cemented in place by warming and then cooling the tube. The final wrapping of asbestos cloth is secured by a bandage of nichrome ribbon. The lengths of ribbon bounding each edge of the mat and the two on either side of the middle are left long enough at one end to serve as electrical terminals. When the heater is wound, these terminals come out at opposite ends of a diameter at one extremity of the tube, and they connect the two halves of the winding in parallel.

This method of winding possesses the following advantages: (1) Any irregularities in the resistance of the heating ribbon are distributed in such a way as to produce a minimum effect upon the longitudinal distribution of temperature. (2) The winding is noninductive. (3) The maximum difference in electrical potential that can occur between adjacent portions of the winding is limited to the drop in a length of ribbon twice as long as the furnace. This makes the danger of arcing by accidental contact considerably less than in the ordinary form of inductive winding. (4) If adjacent windings should accidentally touch, only a short length of ribbon could be short-circuited. (5) Spaces for the side openings down which the length-defining wires are suspended can be provided without affecting the heat supplied per unit length of the furnace tubes. (6) The location of the terminals combines both convenience and safety.

A furnace of the type here described requires considerable time to attain thermal equilibrium. The lag, however, causes no great inconvenience, because in any precise expansion determinations sufficient time should be allowed for the specimen to reach mechanical equilibrium, that is to say, for all unbalanced internal stresses to disappear. The gain in temperature uniformity and constancy more than counterbalances any time lost from avoidable lag. Nevertheless, it seems likely that a furnace amply sufficient for most purposes could be made with considerably less lag. In this connection it might be mentioned that

the principal use of the inner concentric heater is to hasten the attainment of approximate thermal equilibrium. Experience has shown that when the proper adjustment has been secured, the steadying action of the insulation within the outer heater is sufficient to wipe out fluctuations in both losses and supply of heat.[4]

The temperatures and temperature distributions were determined by two thoroughly protected Pt-Pt Rh thermoelements of the best quality in connection with a Diesselhorst potentiometer. The sensitivity was such that one millimeter change in the galvanometer deflection indicated a change in temperature of between 0.058° and 0.086°, depending on the temperature.

Even before the flat end-heating coils were substituted for the coils in the outer conducting blocks of the plugs, fair uniformity throughout the central 30 cm. for which the furnace was designed could be easily obtained by proper adjustment of the heating currents. Good performance was not limited to some particular temperature, as is the case with furnaces in which adjustment of the distribution is attempted by the ordinary cut-and-try method of crowding the windings near the ends. For example, at 667° C. the mean temperature throughout the full 30 cm. was 0.37° lower than the temperature at the center, with a maximum drop of one degree at the extreme ends of the interval; at 145° the mean temperature over the same region was 0.08° lower than at the center, with a maximum drop of 0.25° at the extreme ends.

As an indication of the constancy attainable, it might be mentioned that during the twenty minutes that passed while the observations at 667° were being made the temperature at the center rose 0.067°, or at the rate of 0.2° per hour. During this period no attention whatever was paid to regulation of the heating currents.

[4] The use of two concentric heaters bears some resemblance to the cascade furnace described by Harker (Proc. Roy. Soc. A **76**: 237. 1905), for reaching a temperature of about 2000°C in a heater-tube made of the same material as Nernst lamp glowers. To avoid the necessity of having contacts on this tube capable of carrying relatively large currents, and the consequent severe stress on the parts, it was surrounded by a coil of nickel wire heated by an independent circuit to about 1000°, and insulated from the inner tube by a layer of zirconia. No precaution seems to have been taken to secure uniformity of temperature within.

Greater uniformity of temperature in the central region than had been secured by other experimenters after repeated attempts to adjust properly the crowding of windings was regularly obtained at widely differing temperatures even when heat losses through the ends were reduced merely by the action of the double plugs without supplying any heating current whatever to the coils in the end blocks. Adjustment of the temperature gradient was considerably facilitated by the installation of the flat coils covering the ends of the outer heater tube described above. This change also made it rather easy to produce fair uniformity for the entire length of the heater tubes—32 cm. longer than the bars the furnace was designed to heat.

That no unusual effort is required to obtain moderate uniformity of temperature is shown by the table below, which represents sixteen consecutive runs made while determining the expansivity of a bar of invar. Alongside the temperature observed at the center is recorded

TEMPERATURE DISTRIBUTION IN CONSECUTIVE TRIALS OF AN ELECTRIC FURNACE

TEMPERATURE	CORRECTION	TEMPERATURE	CORRECTION
390°	−0.16°	233°	−0.10°
393	−0.13	214	−0.05
278	−0.03	344	−0.05
271	+0.03	314	−0.10
242	+0.13	445	−0.25
170	−0.04	294	−0.05
188	+0.04	262	+0.03
207	−0.10	175	+0.15

the correction that must be added to obtain the mean temperature throughout the 30 cm. occupied by the bar. In many of the runs the heating currents required to maintain the desired temperature were estimated and switched on late in the afternoon. The furnace was then left to itself over night. The temperature distribution found the following morning was explored and used. Reference to the table shows that in only one case (and that under known unfavorable conditions) did the mean temperature differ by more than 0.16° from that at the center.

ZOOLOGY.—*Nocturnal animals.* AUSTIN H. CLARK, National Museum.

In the discussion of zoögeographical problems, and especially in the reconstruction of hypothetical land bridges over which animals are assumed to have migrated from one region into another, comparatively little attention has been paid to analyzing the data upon which sweeping generalizations are based.

We are tempted to consider as a homogeneous unit all of the animals collectively occurring in any one locality, speaking of this unit as the "fauna" of this locality, and forgetting that in reality it is a heterogeneous collection of animal forms derived from all of the more adaptable and virile types in all the faunal complexes which from the distant past to the present day have swept over the region.

Since in reality the terrestrial animals of any given locality collectively form a heterogeneous faunal complex, instead of a homogeneous entity, it becomes essential that we should endeavor to find some criterion by which this complex may be separated into its original constituents, or at least whereby a beginning may be made in this direction.

On land, abundance of light alternates with a more or less complete absence of light, and we therefore find many animal types which are strictly diurnal, like most birds, many which are strictly nocturnal, like the bats, and many which are indifferently one or the other, like most insects.

Nocturnal animals, properly speaking, are animals which, while capable of performing all their normal functions in the day time, and not dependent upon other nocturnal animals, are active only at night.

Thus none of the amphibians come within the category of nocturnal animals, for the amphibians are active whenever the humidity is high enough so that they are in no danger of dermal desiccation, whether at night or during rains; similarly, though active chiefly or entirely at night, none of the terrestrial crustacea or molluscs are properly nocturnal.

Many of the herbivorous mammals are most active at night, at which time they often make long journeys for water; this is done

to avoid overheating and loss of too much water from the body, and, in many places, to avoid certain insects, such as the species of *Simulium*, *Glossina*, the Tabanidae, etc., which, larger and more dangerous than any nocturnal insects, always breed in or near water and bite only in the daytime.

The predacious mammals and birds are active chiefly (though not by any means entirely) at night for the reason that, following the path of least resistance, they always conform to the habit of taking their prey when it is least able to defend itself, and therefore they must be considered as fortuitously, not as truly, nocturnal.

The day is physiologically the most favorable time for the performance of the normal functions of animals, and at the same time it is the period of greatest meteorological and thermal diversity. Therefore it would seem that new types of animals would always first arise as diurnal species.

If a new animal type arose as a diurnal form, and proved virile and adaptable, it would soon populate all available situations, and would increase so that there would be no room for further additions to its numbers.

But a type sufficiently virile and adaptable to attain such a condition would most assuredly give rise to crepuscular, and finally to nocturnal, forms. It is at this developmental stage that we find, for example, the rodents and the lepidoptera of the present day.

A new type of subsequent origin, of the same habits but economically more efficient, would follow the same course, and therefore would extirpate the diurnal species of the preceding less efficient type long before it had any effect upon the nocturnal species, so that, when the second type had become fully established, we would find it consisting of diurnal and crepuscular species, while the older type would consist of strictly nocturnal species, hiding by day and encroaching upon their more efficient rivals' food supply at night.

This is exactly the process by which the deep sea fauna has been formed from the littoral fauna.

The strictly nocturnal mammals are the elephants, the hippopotamus, the tapirs, the rhinoceros, the sloths, Galeopterus (Cynocephalus), the anteaters, the aard varks, the armadillos, the pangolins, the bats, the opossums, the solenodons, the lemurs (except in Madagascar), and the monotremes (except the aquatic species); among the birds the kiwis and the owl-parrots (Stringops) are nocturnal, and among the reptiles the geckos; among the invertebrates the most striking and isolated nocturnal types are the onychophores and the millipeds.

A glance at this list of strictly nocturnal types brings out many points of interest.

Among the birds and mammals the average size is much greater than that of the diurnal types.

Most of the nocturnal mammals have long palaeontological records, and, collectively, the included groups are considered as much more ancient, primitive and aberrant than the diurnal types.

Taken as a whole the nocturnal animals of the globe indicate zoögeographic affinities very different from those indicated by the diurnal animals; for instance, the nocturnal fauna of America shows a close affinity to that of Africa, and also an affinity with that of Australia, while the occurrence of tapirs, otherwise confined to the Malayan region, is of interest; but the affinity indicated by overwhelmingly the greater part of the diurnal fauna of America is with eastern Asia.

The two fundamental differences in the conditions under which the nocturnal animals live as contrasted with the diurnal are (1) the much lower and more uniform temperature, and (2) the more or less complete absence of light.

It is precisely these two differences which delimit the conditions under which the abyssal marine animals live as contrasted with the littoral marine animals, and we are therefore not surprised to find that the nocturnal fauna of the land corresponds in its relation to the diurnal fauna exactly to the abyssal fauna of the oceans in its relation to the littoral fauna.

This comparison enables us to understand how a given type (as for example the bats), exclusively nocturnal in the tropics,

may become more or less diurnal in the cold northern regions, just as an organism confined exclusively to the abysses in the tropics may become sublittoral, or even littoral, in the antarctic or in the arctic; for the coëfficient of virility and adaptability necessary to enable an animal type to thrive under nocturnal conditions in the tropics, or in the deep sea, is equivalent to that necessary to enable it to exist in unnaturally cold surroundings, or in unnaturally great diurnal temperature variations.

In this short paper no attention has been paid to the innumerable intergrades between the intertidal fauna, and the faunas of the land and of fresh water, or to the singularly instructive faunas of deserts, wet belts, saline lakes, caves, or of abnormal situations in general, nor to isolated island faunas, nor to the characters presented by burrowing animals collectively considered; nor has attention been given to the singular fact that, parallel to the abstract similarity between the nocturnal terrestrial fauna and the abyssal fauna of the oceans, the fresh water fauna is actually more closely allied to that of the deep sea than either is to the littoral fauna from which both have been derived, but in which the ancestral types have been supplanted by more efficient types of subsequent origin which as yet have not intruded either into the fresh water or into the deep sea; though these points, and many others, have a very intimate bearing upon the problem of the nocturnal terrestrial fauna.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

AGRICULTURAL CHEMISTRY.—*Selective adsorption by soils.* E. G. PARKER. Journal of Agricultural Research **1**: 179–188. 1913.

Soils not only have the power of adsorbing dissolved salts from solutions but also of adsorbing one ion at a greater rate than another.

The presence of bases of the soil (Ca, Mg, etc.) in solution after shaking certain salt solutions with or percolating them through a soil is probably not due to a direct chemical reaction of the salt in solution with the silicates of the soil, but to a reaction of free acid, resulting from a selective adsorption of the cation, with the mineral components of the soil. The rate of adsorption of chlorin ions from a solution of potassium chlorid by soils is much less than of potassium ions. The selective adsorption of potassium from a potassium-chlorid solution by a soil increases in amount with the concentration up to a certain point and then remains practically constant. In general, the smaller the soil particles the greater the selective adsorption of potassium from a potassium-chlorid solution. The presence of sodium nitrate decreases the adsorption of potassium from a solution of potassium chlorid by a soil up to a concentration of about 37.5 grams of potassium chlorid per liter and then increases it. The presence of monobasic calcium phosphate does not change appreciably the adsorption of potassium from a potassium-chlorid solution.

Finally, if a mineral fertilizer be applied to a soil and exposed to the rain and thus dissolved and carried through the soil in solution, these substances will be adsorbed (an entirely physical phenomenon) either as a whole or selectively from the solution by the vast surface of the soil particles and will be held there by this same physical force until the plant or subsequent leaching removes it.

The presence of other mineral substances added to the soil may or may not increase or decrease the rate at which this adsorptive phenomenon takes place. E. G. P.

ENTOMOLOGY.—*The Calliephialtes parasite of the codling moth.* R. A. CUSHMAN. Journal of Agricultural Research **1**: 211–237. 1913.

This parasite was introduced into California from Europe in 1904. The start on the work discussed was made with specimens secured from the California State Insectary.

The adult female is about half an inch long, exclusive of the ovipositor, which about equals the body in length. It is long and slender, black with red legs. The male is somewhat shorter and more slender than the female. There is considerable variation in size depending on the larval food supply.

The codling moth is attacked in the larval stage after it has spun its cocoon, the parasite first killing the host by stinging and then depositing a single egg within the cocoon. The egg is white and smooth, 1.5 mm. long and about one-fifth as wide at the widest part, rounded at the cephalic end and tapering toward the caudal end. The incubation period was found to average slightly over two days.

The newly hatched larva is yellowish in color with the head large and distinct. After the first molt the form changes to the normal larval habitus of insects of this class. It feeds externally on the host, entirely consuming the fluid contents. This requires on the average about 7 days, after which the larva spins its cocoon. About 10 days later for females and 7.5 days for males, pupation takes place. The act of pupation requires about 15 minutes for males and 35 to 41 minutes for females, the difference being due to the fact that after exuviation the ovipositor increases greatly in length. The average pupal period for females was about 11 days and for males about 9 days. The average time spent in the cocoon by females was 21.5 days and by males 17.7 days.

Transformation to the adult took place about a day before the emergence from the cocoon. The average total developmental period for females was about 30 days and for males about 25 days.

There were found to be two complete and a partial third generation during the breeding season, a part of the third and all of the fourth constituting the hibernating brood. Hibernation takes place in the full-grown larval stage. The males appear in the spring about 10 days ahead of the females. R. A. C.

ENTOMOLOGY.—*The Occurrence of a cotton boll weevil in Arizona.* W. DWIGHT PIERCE. Journal of Agricultural Research **1**: 89–96, figs. 1–9. 1913.

A new variety of the cotton boll weevil, *Anthonomus grandis thurberiae*, has been found to occur in a state of nature on the co-called Arizona wild cotton, *Thurberia thespesioides*, in mountain canyons of the Santa Catalina, and Santa Rita Mountains of Arizona.

The weevil breeds in the buds and bolls of this plant at altitudes of 4000 to 5000 feet. It can hardly have more than two full generations a year because of the late blooming season of the plant. The species hibernates as an adult in the bolls, remaining in the pupal cell often until September 1, although the majority probably emerge in August.

Attack on the buds begins about August 15. The egg is usually inserted in the lower part of the bud, and this soon drops to the ground. The larva develops and pupates in the fallen bud and emerges in a few weeks. The second generation is probably almost entirely on the bolls.

At Victoria, Texas it has been found that the Arizona variety can breed in cotton and that it can interbreed with the genuine cotton boll weevil.

The greatest significance of the discovery of this weevil lies in the fact that the westward extension of cotton culture has brought cotton production to within twenty miles of one of the canyons where the weevil was actually found.

The apparently greater adaptability of the Arizona form to extremes of climate may also indicate the possibility that this form could successfully endure the severe climate of the western Texas cotton areas where the boll weevil has never succeeded in establishing itself. W. D. P.

ENTOMOLOGY.—*Descriptions of twenty-three new genera and thirty-one new species of Ichneumon-flies.* HENRY L. VIERECK. Proceedings of the U. S. National Museum **46**: 359–386. December 31, 1913.

Describes the new genera Eristernaulax, Macroneuroides, Trachagathis and Zadiolcogaster in the Braconidae, and in the Ichneumonidae the following as new: Aglaojoppidea, Cryptanuridimorpha, Cryptophion, Cryptopterigimorpha, Digonocryptus, Epiopelmidea, Joppocryptus, Lamprocryptidea, Monogonocryptus, Phaenolabrorychus, Photocryptus, Polyaenidea, Polycyrtidea, Polycyrtimorpha, Thymari-

morpha, Zaglyptomorpha and Zamastrus from South America, and Diaglyptidea and Photoptera from Java. The new species described are mostly from South America. J. C. CRAWFORD.

ENTOMOLOGY.—*Miscellaneous contributions to the knowledge of the weevils of the families Attelabidae and Brachyrhinidae.* W. DWIGHT PIERCE. Proceedings of the U. S. National Museum **45**: 365–426. May 23, 1913.

In the portion of this paper dealing with the family Attelabidae the author treats only of the subfamily Rhynchitinae which he divides into two new tribes, giving a key to the species of the genus Eugnamptus, to which most of the North American species belong. In the family Brachyrhinidae the author proposes a new classification in which he describes five new subfamilies, twenty-six new tribes, the new genera Amydrogmus, Hadromeropsis, Bradyrhynchoides, and Glaphyrometopus, and the new subgenera Panscopidius and Neopanscopus, together with twenty-four new species and nine new varieties. J. C. CRAWFORD.

ENTOMOLOGY.—*New potato weevils from Andean South America.* W. DWIGHT PIERCE. Journal of Agricultural Research **1**: 347–351, figs. 1–3, pls. 39–41. January 10, 1914.

During 1913, shipments of potatoes for propagation by the Department of Agriculture from various points on the western slope of South America were found infested by live weevils when received at Washington, D. C.

Three species of weevils were found in these various shipments. Their manner of attack was such that it was extremely difficult to detect infestation in lightly infested potatoes. The larval feeding cell is not usually very large and is entirely within the tuber, although near the surface. Advices from Peru indicate that infested potatoes are not uncommonly served at the table, because of the difficulty of detecting the injury externally.

The species *Rhigopsidius tucumanus* Heller occurs in Argentina, Peru, Bolivia, and Chile.

The other species, both representing new genera are found in Peru. These species are described as *Premnotrypes solani*, n. sp. and *Trypopremnon latithora*, n. sp. W. D. P.

REFERENCES

Under this heading it is proposed to include, by author, title, and citation, references to all scientific papers published in or emanating from Washington. It is requested that authors coöperate with the editors by submitting titles promptly, following the style used below. These references are not intended to replace the more extended abstracts published elsewhere in this JOURNAL.

PALEONTOLOGY

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EVOLUTION

COLLINS, G. N. and KEMPTON, J. H. *Inheritance of waxy endosperm in hybrids of Chinese maize.* IV^e^ Conférence Internationale Génétique, Paris, **1911**: 347–357. 1913.

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BOTANY

BARTLETT, H. H. *Systematic studies on Oenothera,—II. The delimitation of Oenothera biennis L.* Rhodora **15**: 48–53, pl. 102, 103. April 12, 1913.

BRITTON, N. L. and ROSE, J. N. *Studies in Cactaceae,—I.* Contributions from the U. S. National Herbarium **16**: 239–242, pl. 66–73. April 10, 1913. (Includes descriptions of 7 new species in Echinocactus, Epiphyllum, Hylocereus, Nyctocereus, Opuntia, and Wittia.—W. R. M.)

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ENTOMOLOGY

ALEXANDER, C. P. *A revision of the South American dipterous insects of the family Ptychopteridae.* Proceedings of the U. S. National Museum **44**: 331–335. February 20, 1913. (Includes description of a second South American species, *Tanyderus patagonicus.*—J. C. C.)

ALEXANDER, C. P. *A synopsis of part of the neotropical craneflies of the subfamily Limnobinae.* Proceedings of the U. S. National Museum **44**: 481–549, pls. 65–68. April 30, 1913. (Treats of the tribes Eriopterini and Limnophilini and describes thirty-seven new species and three new subspecies. The author gives keys to the genera and species included.—J. C. C.)

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CAUDELL, A. N. *Notes on nearctic orthopterous insects. I. Nonsaltatorial forms.* Proceedings of the U. S. National Museum **44**: 595–614. April 18, 1913. (Describes one new species and gives keys to the genera and species of various groups.—J. C. C.)

CAUDELL, A. N. *Results of the Yale Peruvian expedition of 1911. Orthoptera (exclusive of Acridiidae).* Proceedings of the U. S. National Museum **44**: 347–357. February 20, 1913. (Describes nine new species in several genera. —J. C. C.)

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DYAR, H. G. *Descriptions of new Lepidoptera, chiefly from Mexico.* Proceedings of the U. S. National Museum **44**: 279–324. February 11, 1913. (Describes the following new genera: Epimolis in the Arctiidae; Hypenopsis in the Noctuidae; Calomathetes in the Notodontidae; Edia, Paranatula and Ballovia in the Pyralidae. A total of 117 new species and one new subspecies in several families are described.—J. C. C.)

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MALLOCH, J. R. *A Synopsis of the genera of Agromyzidae, with descriptions of new genera and species.* Proceedings of the U. S. National Museum **46**: 127–154, pls. 4–6. December 6, 1913. (Gives keys to the subfamilies, tribes, genera and to the American species of some of the genera; describes Paraleucopis, Paramiliohia and Euchlorops, new genera; proposes Paramadiza, new name for Madiza of authors, not of Fallen; describes eleven new species.—J. C. C.)

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VIERECK, H. L. *Descriptions of six new genera and twelve new species of Ichneumon-flies.* Proceedings of the U. S. National Museum **44**: 639–648. April 18, 1913. (Describes the new genera Amyosoma, Arichelonus, Diachasmimorpha, and Shirakia in the family Braconidae, and Eripternimorpha and Zaparaphylax in the family Ichneumonidae.—J. C. C.)

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